

**I Claim:**

1. A paper or paperboard having improved bulk and stiffness comprising:
  - a three layered single-ply I-beam structure having a top layer, a central layer and a bottom layer, wherein the central layer is a cellulosic core layer, and the top and bottom layers are starch based, size-press applied coating layers that cover an upper and lower surface of the central layer with minimal penetration into the central layer, and
  - a bulking agent interpenetrated within the central layer.
2. The paper or paperboard of claim 1, wherein the ratio of the thickness of the central layer compared to the thickness of the paper or paperboard is between 1:50 and 1:1.1.
- 10 3. The paper or paperboard of claim 1, wherein the basis weight of the paper is between 59 g/m<sup>2</sup> and 410 g/m<sup>2</sup> and the basis weight of each of the top and bottom coating layers are between 2 and 10 g/m<sup>2</sup>.
4. The paper or paperboards of claim 1, wherein the top and bottom layers have starch application controlled with a metered size press.
- 15 5. The paper or paperboards of claim 1, wherein the top and bottom layers are formed from an starch coating solution having starch solids between 6% and 20% weight.
6. The paper or paperboard of claim 1, wherein the bulking agent is diamide salt based product.
- 20 7. The paper or paperboard of claim 1, wherein the bulking agent is made from a polymeric material in form of microspheres selected from the group consisting of methyl methacrylate, ortho-chlorostyrene, polyortho-chlorostyrene, polyvinylbenzyl chloride, acrylonitrile, vinylidene chloride, para-tert-butyl styrene, vinyl acetate, butyl acrylate,

styrene, methacrylic acid, vinylbenzyl chloride and combinations of two or more of the foregoing.

8. The paper or paperboard of claim 7, wherein the central layer further comprises a retention agent.

5 9. The paper or paperboard of claim 1, wherein the central layer further comprises an additive selected from the group consisting of fillers, surfactants, sizing agents, or a combination thereof.

10. The paper or paperboard of claim 1, wherein the starch is selected from the group consisting of hydroxy ethylated starch, oxidized starch, cationically modified or enzymatically converted starch from any regularly used starch source, such as from potato, 10 corn, wheat, rice or tapioca.

11. The paper or paperboard of claim 1, wherein the top and bottom layers further comprise a cross linking agent.

12. The paper or paperboard of claim 1, wherein the top and bottom layers further 15 comprise a viscosity modifier.

13. The paper or paperboards of claim 1, wherein the top and bottom layers further comprise a pigment.

14. The paper or paperboard of claim 1, further comprising additives selected from the group consisting of polyvinyl alcohols, ammonium zirconium carbonate, borate 20 chemicals, glyoxal, melamine formaldehyde, ground and precipitated calcium carbonates, clays, talc, TiO<sub>2</sub>, and silica., or a combination thereof.

15. A paper or paperboard having improved bulk and stiffness comprising:  
a three layered single-ply I-beam structure having a top layer, a central layer  
and a bottom layer, wherein the central layer is a cellulosic core layer, and the top and bottom  
25 layers are starch based, size-press applied coating layers that cover an upper and lower

surface of the central layer, a starch coat weights of each of the top and bottom coating layers being between 2 and 10 g/m<sup>2</sup>, and

a bulking agent interpenetrated within the cellulosic core layer

16. A method for making a paper or paperboard comprising the steps of:

- 5 a) providing a furnish including cellulosic fibers and a bulking agent,
- b) forming a fibrous web from the papermaking furnish,
- c) drying the fibrous web to form a dried web,
- d) size-press treating the dried web with a high strength starch based size-press solution to form top and bottom coating layers on a top and bottom side of the fibrous web,
- 10 and
- e) drying the fibrous web after the size-press treatment to form a three layered single-ply having an I-beam structure.

17. The method of claim 16, wherein the ratio of the thickness of the fibrous web compared to the thickness of the paper or paperboard is between 1:50 and 1:1.1.

15 18. The method of claim 16, wherein the basis weight of the paper is between 59 gsm and 410 gsm and the basis weight of each of the top and bottom coating layers are between 2 and 10 gsm.

19. The method of claim 16, wherein no substantial levels of starch from the top and bottom coating layers are in the fibrous web.

20. The method of claim 16, wherein the top and bottom coating layers have starch solids less than 20% weight.

21. The method of claim 16, wherein the size-press treatment uses a metered size-press.

22. The method of claim 16, wherein the bulking agent is a diamide salt based product.

23. The method of claim 16, wherein the furnish further contains an additive selected from the group consisting of: fillers, surfactants, or a combination thereof.

24. The method of claim 17, wherein the starch is chosen from a group comprising of: hydroxy ethylated starch, oxidized starch, cationically modified or enzymatically converted starch from any regularly used starch source, such as from potato, corn, wheat, rice or tapioca.

25. The method of claim 16, wherein the size-press solution further contains an additive selected from the group consisting of: polyvinyl alcohols, ammonium zirconium carbonate, borate chemicals, glyoxal, melamine formaldehyde, ground and precipitated calcium carbonates, clays, talc,  $TiO_2$ , and silica., or a combination thereof.

26. The method of claim 17, wherein a starch solution of the high strength starch based size-press solution is pre-cooked with a borate chemical prior to the size-press treatment.